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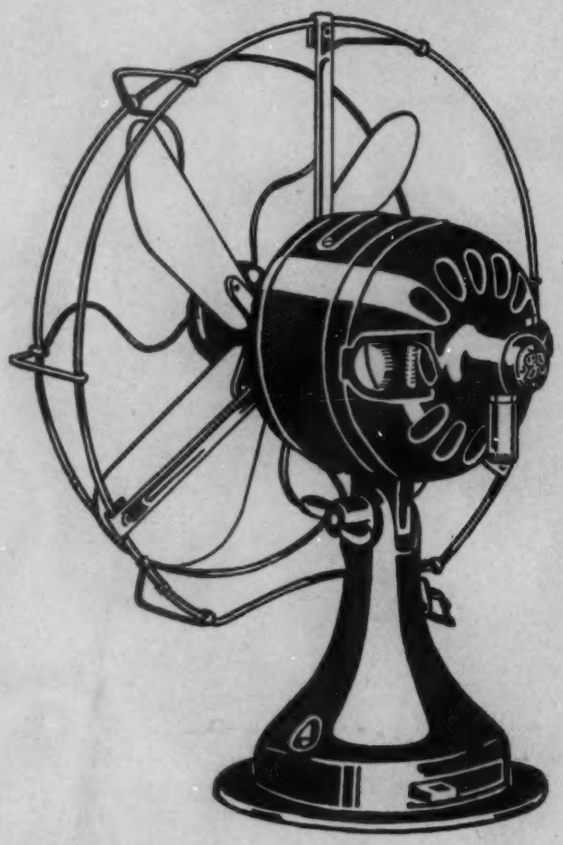

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ELECTRO-METALLURGICAL USES OF SURPLUS POWER

BY WILLIAM STRONG.

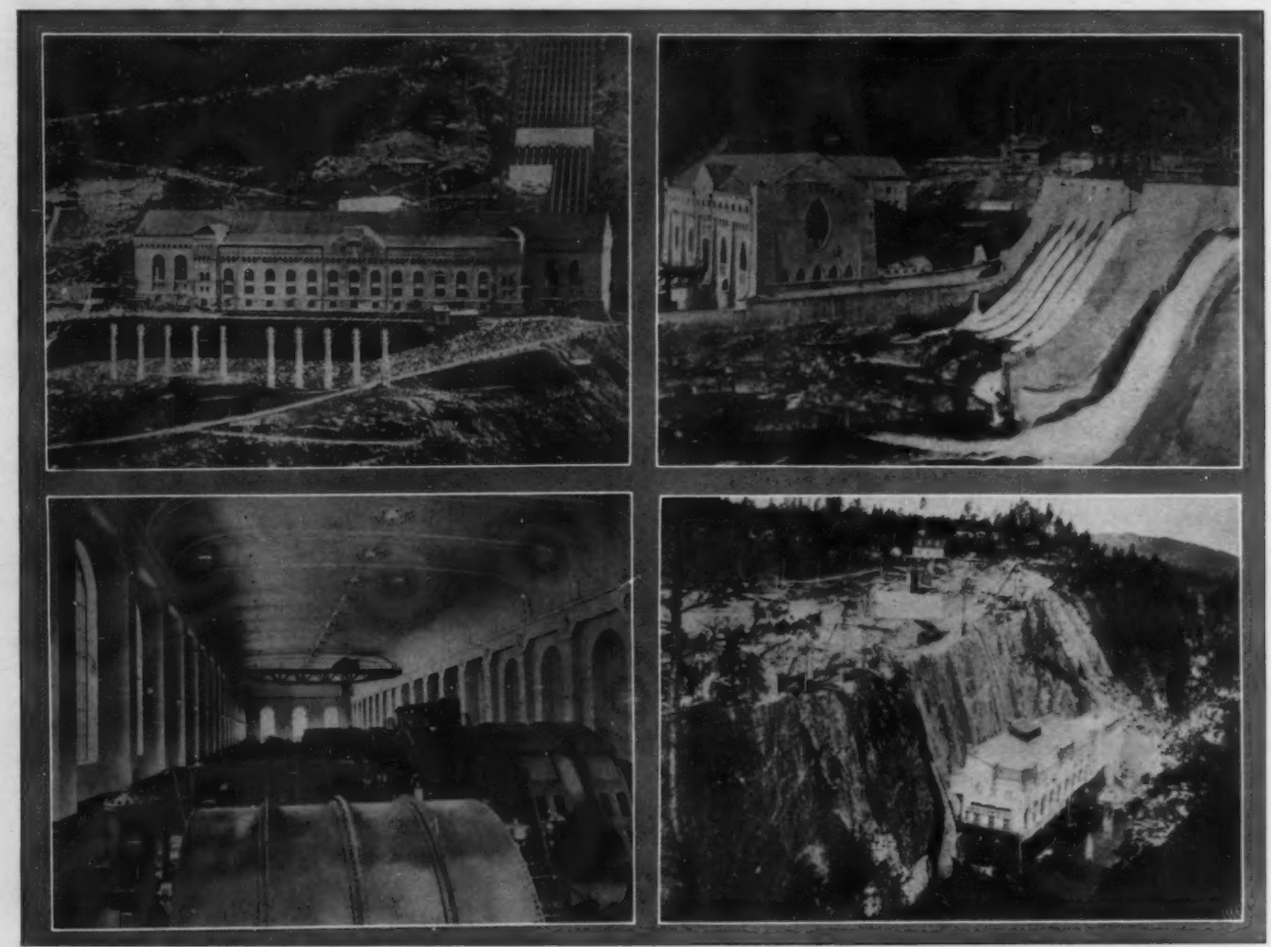
The problem of Western use of surplus electric power confronts a number of Western hydroelectric projects and the purpose of this paper is to suggest a possible solution. All electrochemical and metallurgical plants operating in Europe and in the United States receive their electric power at a cost ranging from about $3 per kw.-yr. in Norway to $20 to $30 in Germany and at Niagara Falls, the larger plants using from 18,000 to 30,000 electrical horsepower, continuous service. While these rates would not yield much direct profit to an operating hydroelectric company, profit should be obtained indirectly by increase of population and consequent market for domestic consumption.

Whether or not it may be profitable for any particular hydroelectric company to engage in the manufacture of any of the products mentioned in the following lists depends upon several conditions and each case should be the subject of special study.

The principal factors to be considered may be stated as follows:

Quantity of electric power available for continuous use and low cost of same to the manufacturer.

Location of proposed electrochemical or metal-



Close View of Power Plant and Steel Pipe Lines at Rjukan, Norway.

Interior of Power Plant at Rjukan.

Power Station at Lienfos, Norway, Developing 20,000 h.p., all of which is Used in the Manufacture of Nitrate of Lime at the Notodden Nitrate Factory.

Power Station at Svaelgpos, Norway, Developing 40,000 h.p., all of which is Used in the Manufacture of Nitrate of Lime at the Notodden Nitrate Factory.

lurgical works with reference to raw materials, railroads and markets.

Freight rates on raw materials and finished products.

Available raw materials, cost and quality of same.

Cost and supply of labor.

At the present time the following electrochemical or metallurgical products are manufactured:

In Europe—

Nitric acid by fixation of atmospheric nitrogen.	Calcium cyanamide.
Nitrates of ammonia, lime, etc.	Sodium cyanide, caustic soda, etc.
Hydrochloric acid, chlorine, etc.	Ferro-silicon, ferro-carbon, etc.
Calcium carbide.	Tungsten metal and alloys.
	Aluminum and alloys.

In the United States, principally at Niagara Falls—

Aluminum.	Tungsten metal and alloys.
Carborundum.	Titanium bronze.
Calcium carbide.	Silicon-copper, Manganese-copper.
Chlorinated lime.	Steel castings.
Chlorate of potash, caustic soda, etc.	Zinc refining.
Ferro-silicon.	Copper reduction from ores.
Graphite, electrodes, etc.	Zinc reduction from ores.

Nitrates.—The nitrogen problem of the day is being solved by electricity and offers an opportunity for the utilization of cheap electrical power where transportation and market conditions are favorable.

According to a special report on the Utilization of Atmospheric Nitrogen by the U. S. Consul at Chemitz, Germany, the United States, before the European war commenced, was sending annually over $32,000,000 abroad for the purchase of nitrogen products. Over one-half of this amount went to Chile for crude sodium nitrate, Chile saltpeter. The nitrate beds of Chile are approaching exhaustion and on account of the increase in price of both raw material and finished products it is now possible for the electrochemical plants in Norway and Germany to successfully compete with production from Chile nitrate by the fixation of nitrogen from the air and the manufacture of nitric acid and other products.

During the latter part of the 18th century the discovery was made that an electric spark passing through the air caused an acid reaction. Since that time the problem of chemically combining the oxygen and nitrogen of the air has engaged the attention of many scientists. Up to 1899 but little progress seems to have been made outside of laboratory experiments and demonstrations. During 1899 MacDougal and Howles erected a small nitric acid plant in England in which eight arcs were arranged in a row and the alternating current of a dynamo of 7500 volts and 50 cycles was used. It produced from air 34 grams of nitric acid per kw.-hr. Many mechanical difficulties were encountered and an industrial plant was not attempted. Since 1899 great progress has been made in the perfection of mechanical details. In 1911 Birkeland and Eyde successfully established a plant for the manufacture of nitric acid by combining nitrogen and oxygen of the air. This plant was located at Notodden, Norway, where 55,000 electrical horsepower was in use and over 400 workmen employed. Thirty-two 4000 kw. furnaces were in operation requiring 35,000 cu. ft. of air per minute. The reaction took place at a temperature of about 3000 deg. C., 2 per cent of the nitrogen in the air passing through the furnaces was oxidized to nitric acid, equivalent to a production of 70 gramms of nitric acid per kw.-hr. The cost of electricity used at the Notodden works is reported to be $2.94 per electrical hp.-yr.

The nitrogen fixation furnaces used is described as follows:

The individual furnace may be described as a low, wide cylinder resting upon its side and placed between the arms of an enormous horse shoe magnet. The cylinder is made of heavy iron plate and consists of similar halves which are bolted together. The interior is lined with refractory brick so arranged that in the middle there is a narrow, circular chamber, over two meters in diameter and 10 centimeters in width. In this circumscribed space the reaction takes place. The huge terminal poles of the wrought-iron electromagnet, bevelled at the extremes, are imbedded in the chamotte lining and are about 22 centimeters apart, their axis corresponding with that of the chamber. The electrodes are of copper with internal circulation of water and are 1.5 centimeters in diameter. They enter the chamber from opposite sides and are separated from each other at its centre by an interval of 2 millimeters. Air under pressure is admitted to passages between the external shell and the chamotte lining and enters through numerous small inlets in the latter into the reaction chamber. The gaseous current issues, through openings in the periphery of the chamber, into a conduit which leads to the absorption apparatus. A small window of mica in the front of the furnace allows inspection of the operation. A direct current feeds the coils of the big magnet placed immediately outside the iron shell and an alternating current is connected with the electrodes. This current is of 5000 volts, 50 cycles. When in uninterrupted operation the electrodes are changed every three or four weeks while the refractory lining is removed once or twice a year. Repairs are easy to make and the cost slight. A series of such furnaces may be kept in operation for weeks without special regulation and reveal exceedingly slight variations in energy.

Research chemists and electrical engineers have been constantly at work improving the details of the process and construction of electric furnaces and it is probable that nitrogen fixation plants can now be designed of much higher efficiency than that described.

In general it may be stated that under present and future conditions of the nitrate industry and the increasing demand for nitric acid and nitrates in the manufacture of explosives, fertilizers, etc., it is probable that some of the hydroelectric plants of the West are so situated that their surplus electrical power could be profitably used in the manufacture of nitrogen products.

As an indication of the importance of this subject Congress has passed a bill providing for the appropriation of $20,000,000 for the construction of nitrogen fixation plants. The main features of this bill follow:

The President of the United States is authorized to cause to be made, such investigation as in his judgment is necessary to determine the best, cheapest, and most available means for the production of nitrates and other products for munitions of war and useful in the manufacture of fertilizers and other useful products by water power and any other power as in his judgment is the best and cheapest to use; and is also authorized to designate for the exclusive use of the United States, such sites upon any navigable or non-navigable rivers or upon the public lands, as in his opinion

will be necessary for carrying out the purposes of this act; and is further authorized to construct, maintain, and operate, at or on any site or sites so designated, dams, locks, improvements to navigation, power houses and other plants and equipment or other means than water power as in his judgment is the best and cheapest, necessary or convenient for the generation of electrical or other power and for the production of nitrates or other products needed for munitions of war and useful in the manufacture of fertilizers and other useful products.

The products of such plants shall be used by the president for military and naval purposes to the extent that he may deem necessary, and any surplus which he shall determine is not required shall be sold and disposed of by him under such regulation as he may prescribe.

The sum of $20,000,000 is appropriated out of any moneys in the Treasury not otherwise appropriated, available until expended to enable the President of the United States to carry out the purposes herein provided for. The plant or plants provided for under this Act shall be constructed and operated solely by the government and not in conjunction with any other industry or enterprise carried on by private capital.

In order to raise the money appropriated by this Act and necessary to carry its provisions into effect, the Secretary of the Treasury upon request of the President of the United States, may issue and sell or use for such purpose or construction hereinabove authorized any of the bonds of the United States now available in the Treasury of the United States under the Act of August 5, 1909, the Act of February 4, 1910, and the Act of March 2, 1911, relating to the issue of bonds for the construction of the Panama Canal to a total amount not to exceed $20,000,000; provided, that any Panama Canal bond issued and sold or used under the provisions of this section may be made payable at such time after issue as the Secretary of the Treasury after date of issue as the said Act of August 5, 1909, not exceeding $50.

Carborundum.—At Niagara Falls the Carborundum Company's plant, covering about 15 acres, has a capacity of 12,500,000 lb., annually, of abrasives. They operate 30 of the largest and hottest electric furnaces in the world. Carborundum is the trade name given to carbide of silicon. The element carbon is supplied by crushed coke and silicon by sand. These two materials, together with sawdust and sand, are mixed in certain proportions and loaded into the electric furnace, which is a large rectangular affair built of fire brick. It is about 20 ft. long, 7 ft. wide and 6 ft. high. At each end of the furnace are thick cables connected to carbon electrodes. Through the mixture of coke, sand, sawdust and salt the current is turned on and a heat approximating 7000 deg. F. passes through the crude materials. Eighteen thousand h.p of electric energy generated by Niagara Falls is used.

Calcium carbide is manufactured in Norway and other points in Europe where cheap power is available as well as at Niagara Falls, Sault Ste Marie, Duluth and other points in the United States. Fifty-six carbide plants are reported in operation in Europe and sixteen in the United States and Canada. The larger plants abroad and in this country require from 30,000 to 40,000 electrical horsepower. In the manufacture of calcium carbide limestone as free as possible from magnesia and alumina is used together with ground coke or anthracite coal. Burnt lime and ground coke or coal in about equal parts are charged into an electric furnace of special type and the mixture is raised to a temperature of about 3000 deg. C. when chemical union of the calcium and carbon takes place.

At some European plants calcium carbide is made the basis of the manufacture of calcium cyanamide. This is accomplished by heating the ground carbide in an atmosphere of nitrogen.

Calcium cyanamide containing 35 per cent nitrogen,—more than twice the amount present in Chile saltpeter,—when properly used, has proved to be an excellent nitrogen fertilizer for many crops and quite equal to ammonia compounds into which it can be readily converted. The cost of manufacturing calcium cyanamide in Norway is stated as being $22 per ton.

Aluminum.—The raw material from which this metal is usually made is bauxite, deposits of which occur in Georgia, Arkansas, Alabama and elsewhere. The amount of bauxite mined in 1907 is stated as being 260,000 tons, three-fifths of which was produced in France. The present electrochemical process of manufacture involves the following stages:

(a) Hydrate of alumina is precipitated from a solution in which the metal is present as sodium aluminate.

(b) The precipitate is calcined at a temperature of about 1100 deg. to 1200 deg. C.

(c) The calcined precipitate is treated in an electric reduction furnace.

The reduction furnace for aluminum consists essentially of an iron casing lined with carbon. The electrodes vary in size and form in different works. Their total sectional area is adapted to the current used. In starting a furnace it is usual to first introduce cryolite which is brought to fusion by electrical heat. Calcined alumina hydrate is then gradually fed in at the surface of the fused cryolite and as it dissolves the resistance gradually falls 5 or 6 volts and the temperature of the bath will generally be about 1000 C., at which temperature electrolytic reduction of the metal takes place.

Carbon electrodes, an important item of expense in the operation of electric furnaces, are made from bituminous or anthracite coal, coke, retort carbon, natural or artificial graphite, soot, oil cake, etc. A process for making electrodes for the manufacture of aluminum is described as follows: Oil and coke is ground with the admixture of tar or other binder material and is subjected to high pressure in moulds. The pressed shapes are then baked in a specially designed kiln, the surface of the electrodes being protected by embedding them in carbon.

According to the Transactions of the American Electrochemical Society and other publications a large amount of experimental and research work has been done in efforts to attain commercial success in the design of electric furnaces for making steel castings, reduction of tungsten and the manufacture of tungsten alloys, titanium bronze and the reduction of all metals requiring a high temperature and electrical treatment.

The electrolytic reduction of zinc from certain ores is reported to be in successful operation.

Regarding electro-chemical and metallurgical processes the technical knowledge of the processes is generally well advanced but there is a large field for research laboratories where the mechanical problems in the design of commercial plants may be solved.

ELECTRIC POWER FOR IRRIGATION PUMPING

DEPARTMENT CONDUCTED BY S. T. HARDING

RATE OF DEVELOPMENT OF IRRIGATION PROJECTS.

The rate of development of any undertaking is of importance in determining the period during which such development is only partially used and the amount of operation cost which has to be carried until a going concern is established. This is of particular importance for irrigation systems where such non-productive or partially productive periods are longer than in many other forms of industrial development, so that the interest charges on the construction cost during this period may be quite large. It is also of importance to power companies supplying large pumping units, as the rate of extension of the irrigated area is a measure of the rate of increase in the power consumption.

For small individual systems, such as pumping from wells or for small gravity canals, diverting for only one or two farms,—a type of development usual in the earlier days in the mountain states,—the rate of extension of use depended on the efforts of those constructing the ditches. In the larger systems, more typical of present developments, the use of the water and actual preparation and irrigation of the land usually depends on others than those constructing the systems. It is often necessary for those making the development to secure the settlers who are to use the land and water. In such cases longer periods are required for the actual cultivation of the land and the full use of the canal capacity. This is true also of the larger developments made by the land owners under some of the forms of co-operative organization.

The need of longer periods for the actual application of water to beneficial use on the larger units usual in present new systems has been recognized by changes in the laws of the different states. In order to acquire water rights by appropriation, diligence in construction and actual use of the water is essential. For the earlier systems the usual statutory period for completing an appropriation was five years. This has been found to be too short, and a total of 14 years for construction and use may now be allowed in some states, while in others authority is given to the state engineer, or other equivalent officials, to fix the period of time for each appropriation. The latter method is preferable, as it allows the time to be adjusted to the magnitude of each case.

The rate of increase in irrigated area varies widely with different systems. There are instances where the full area under a canal has been placed under cultivation in a few years. There are other instances where, due to inherent weakness in the development, such as poor water supply, soil, or excessive costs, the extension of the irrigated area has been very slow. A change in conditions, such as a failure to realize anticipated profits from the crops, may cause an actual decrease in the area irrigated. There is, however, some range of rate of development which is representative of well-handled feasible projects under normal conditions. Available records from different sources are given in the following discussion.

In the 13th U. S. Census, taken in 1910, the acreage actually irrigated in 1909, the total acreage under the canal and the date when each system was initiated was secured for each canal. From this information, the percentage of the total area irrigated for the number of years since each system had been initiated was figured. In a recent book (Irrigation in the United States, D. Appleton & Co.) by R. P. Teele, who was in charge of the last irrigation census, the results for 522 canals supplying 5000 acres or over are plotted, a mean curve for the percentage irrigated for different ages being drawn. This is reproduced in Fig. 1. The

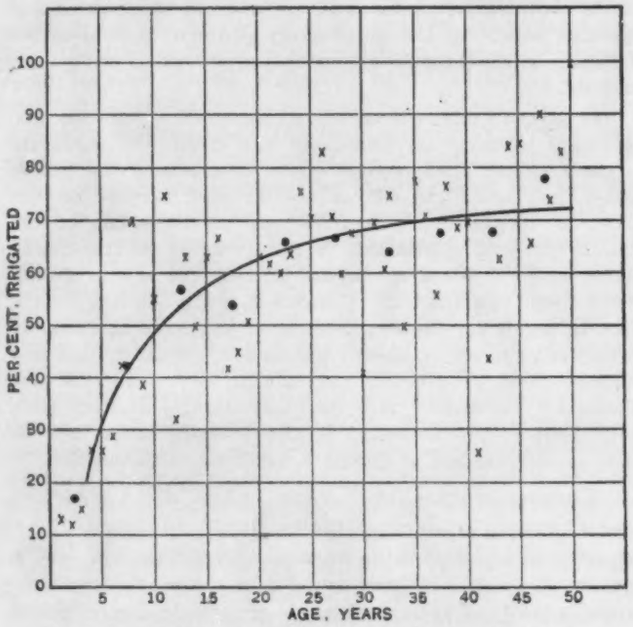


Fig. 1. Average Increase in Rate of Irrigated Area from Date of Initiation of Systems.

number of records available for systems operated over 40 years are relatively few, and this part of the curve is not as definite as that for shorter periods of time.

It is noticeable that this curve, even for systems in use over 30 years, shows but little over 70 per cent of the area to be actually irrigated. The total area for which systems were completed in 1910 was given by the census as 19,340,000 acres, the area actually irrigated in 1909 was 13,740,000 acres or 71 per cent of the area available.

From these figures Mr. Teele draws the conclusion that at the end of ten years from its initiation, the average irrigation project is watering about fifty per cent of its land; at the end of twenty years it is watering a little more than sixty per cent; at the end of thirty years it is watering less than seventy per cent, and at no time will it water more than seventy or eighty per cent of its land.

These figures include both the construction period and the settlement period. The length of each of these periods for any project depends on different con-

ditions which may be independent of each other. It would seem preferable to consider them separately. The length of time required for construction depends on the physical conditions of the particular project and the financial condition of its promoters. The time for physical construction can be closely estimated for different financial programs. Delays due to financing are distinct from delays due to the failure to actually irrigate the land after the project is in operation. The rate of increase of the irrigated area depends mainly on agricultural conditions and the efforts of those using the land; the time of construction depends on engineering conditions and the efforts of those constructing water works.

The data from the general census only give the conditions for one year in the history of each system. Probably a better average can be secured by taking the complete history of different systems and plotting the percentage irrigated each year for a series of years. The only group of systems for which such data are available are those of the U. S. Reclamation Service. In Table I the results for various of these projects are given. The total completed acreage in each project on which the percentages are computed are those given in the 14th Annual Report of the Reclamation Service. This total is the area for which water could have been supplied in 1914; many of the projects will ultimately contain larger acreages. The areas irrigated in each year were secured from the different published reports.

The times are dated from the first year of operation. As on most of the projects, certain portions were completed and placed on an operation basis before the completion of the whole project, these figures, in some cases, may be somewhat incorrect. The total area used for computing percentages is that given as ready to be irrigated in 1914; in a few cases additional units were added in 1915 so that the percentages may be somewhat high for the last year shown. Such factors will affect the figures for some individual projects; the general average should be as dependable as can be expected in data on questions of this kind.

There were twenty-three projects operated in 1914. Only fourteen of these are given in Table I. The remainder were omitted because they include projects

Table I.—Rate of Increase of Area Irrigated on Projects of U. S. Reclamation Service.

Project.	Area Irrigable in 1914, Acres.	Per Cent of Irrigable Area Irrigated Each Year of Operation. 1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.
Yuma, Arizona.....	60,000	6	11	17	17	23	33	42	46	..
Orland, Cal.	14,300	5	19	30	46	51	63	..	..	..
Minidoka, Idaho	117,000	13	21	37	39	48	60	65	70	71
Huntley, Mont.....	28,800	14	21	28	42	50	55	59	63	..
Sun River, Mont.....	16,400	18	26	42	42	45	40	26	..	..
Lower Yellowstone, Mont.	36,200	20	24	43	14	21	16	35	..	..
North Platte, Neb.....	91,500	25	46	50	51	58	66	70	76	..
Truckee-Carson, Nev....	52,000	29	40	42	56	53	58	70	83	83
Umatilla, Oregon.....	17,000	4	12	14	20	26	28	30	31	..
Klamath, Oregon.....	38,000	23	26	57	68	63	62	50	64	72
Belle Fourche, So. Dak..	68,800	6	8	22	29	40	48	54	64	..
Okanogan, Wash.....	10,100	14	34	44	64	72	76	77	78	..
Tieton, Wash.....	34,000	5	21	44	55	62	65	..	..	..
Shoshone, Wyo.....	41,200	4	22	36	39	40	47	54	62	..
Mean, 14 projects....	615,300	13	24	36	41	47	51	53	64	..

with which areas previously irrigated are included, such as projects where the Reclamation Service either purchased and enlarged old systems or supplied supplementary storage for canals previously built. For such systems the data for the operation previous to the work of the Reclamation Service is not available. The projects given in Table I are those where new systems were built.

The period between authorization of the project and delivery of water or the construction period varied from 2 to 5 years, averaging 3½ years. Authorization followed the general examination of the project, which required an additional period of time. In considering the time of non-productive investment for projects of this size, it would appear that interest on costs would have to be carried over an average construction period of 3½ years, or an equivalent of perhaps 2 years on the full construction costs. This is recognized in the

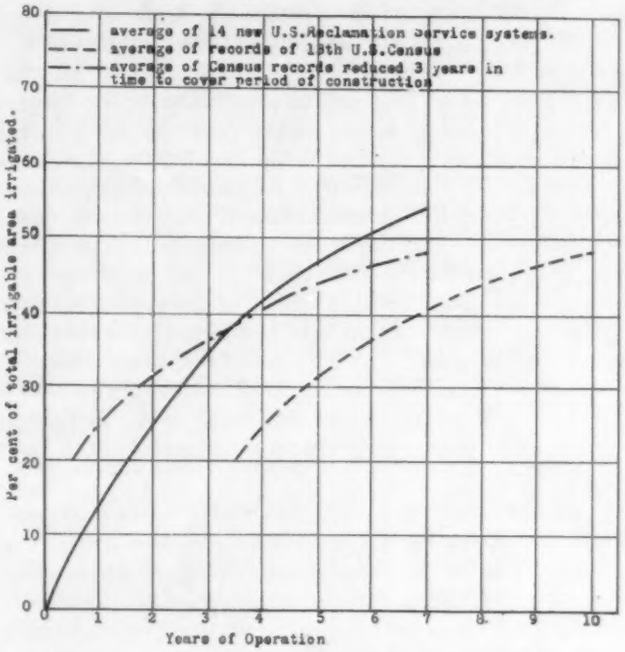


Fig. 2. Average Rate of Increase of Irrigated Area on Project.

irrigation district laws of some of the states which permit the first two years' interest on bonds to be paid from the funds received from their sale. In addition to this non-productive period, a partially productive period as shown by the rate of increase in irrigated area would have to be allowed for.

The average results of these 14 projects are plotted in Fig. 2. Records for all projects are only available for 6 years; the portions for longer times are partial averages, as indicated in Table 1. In comparison with the average curve obtained from the census, the average rate of increase of irrigated area on these Reclamation Service projects has been good.

In Fig. 2, the general curve from Fig. 1 is also plotted and the same curve reduction of three years to cover estimated average construction period. This comparison shows the government projects, as an average, to be developing more rapidly than the indicated average for the 522 systems reported by the census. On a few projects the rate of development has been slow, and some decreases have occurred. Taken on the whole, however, the average should indicate the normal rate of development to be expected on well considered projects of average feasibility. There is no evidence of different rates under different climatic conditions, each project having a development in proportion to its individual conditions and merits.

Similar records for other forms of organization are not available. Individual examples showing both slower and also more rapid increases in irrigated area could probably be secured. Whether the average curve for other forms of organization would be below or above the curve for the Reclamation Service cannot be stated. The largest source of difference would be caused by the more favorable financing of the government projects, as the delays due to lack of funds for completion which have occurred with many systems financed by private means have not been serious with the Reclamation Service.

The wide variation in rate of development that may occur under generally similar climatic and soil conditions can be illustrated by three irrigation districts in California. The Modesto Irrigation District spent a period of 16 years in construction, the largest part of this being due to legal controversy, and required 10 years' operation before one-half the land was irrigated. The adjoining Turlock District similarly spent 13 years in construction and 14 years in operation before one-half the area was irrigated. The South San Joaquin Irrigation District did not organize until some years after both of these districts were under operation. Construction was completed in about four years, and now in its third year of operation about 40 per cent of its area is irrigated. The difference is due to a higher land value and cost of the irrigation system and to the construction of laterals to each farm by the district.

In the Imperial Valley, Imperial Water Company No. 1 was irrigating 80 per cent of the land under it in nine years after delivery began, this period including that covering the Colorado River breaks. The more rapid rate here is probably due to the greater aridity of the climate and the inability to secure any returns from the land without irrigation.

These results indicate that a normal rate of development to be expected on large projects will result in having one-half the area irrigated in about 6 years after operation begins, or about 9 or 10 years from the beginning of construction. An additional period of three years should increase the irrigated area to about 60 per cent of the total. Under usual conditions, the actual irrigation of about eighty per cent of the irrigated area would be considered complete development. On systems lacking some of the essential elements of feasibility, the rates of progress may be only one-half as rapid, or actual decreases may occur. Interest charges must be carried over these periods to a greater or less extent and also some operation deficit. Where only a portion of the lands are in use, it is not generally possible for such lands alone to carry the actual cost of operation and maintenance of the whole system. Some means of assessing lands not irrigated or the carrying of such deficits in construction accounts must be provided. The present tendency is to extend the time of payment for the lands and irrigation system. This increases the capital required by the constructing organizations.

Where large pumping plants are used for irrigation, the power consumption per acre irrigated is larger in the first years of operation than after the development has become complete. This is due to the greater proportion of the water lost in conveyance with small flows and to the generally lower duty secured in the irrigation of new or raw lands. The curves for power consumption, if plotted on Figs. 1 and 2 as percentages of the total ultimate consumption, would, for average systems, be above the curve for the rate of increase of the irrigated area, approaching full consumption when about 80 per cent of the area was actually irrigated.

POWER REQUIREMENTS FOR IRRIGATION PUMPING.

The units commonly used to express the results accomplished in pumping for irrigation are gallons per minute and second feet for rate of use and acre feet

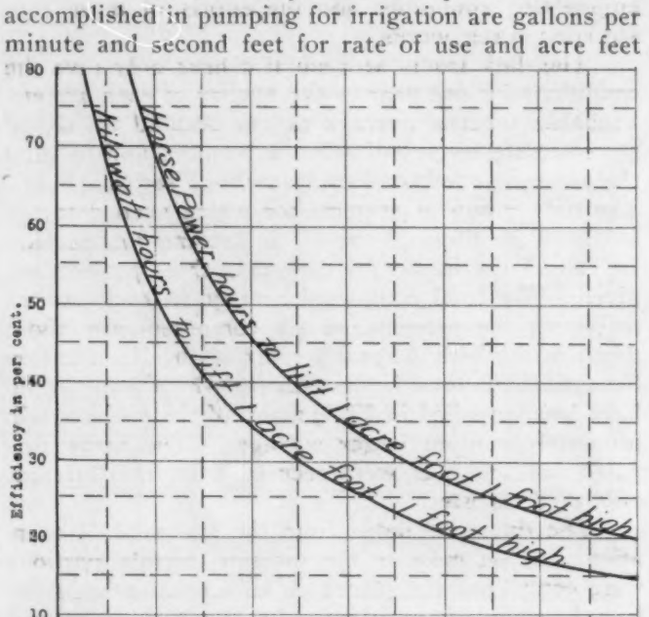


Fig. 1 Power Required to Lift 1 Acre Foot of Water 1 Foot High for Different Efficiencies.

for units of quantity. Pump ratings are expressed in gallons per minute. The use of water in relation to the area served is more usually expressed in terms of the area served per second foot of supply.

Figs. 1, 2, and 3 give the power required for pumping per foot of lift. In Fig. 1, the horsepower and kilowatt hours required to raise one acre foot of water one foot with different efficiencies are shown. The efficiency of irrigation pumping plants varies widely; on large well built plants the overall efficiency may be as high as 65 per cent over all; on small plants, poorly maintained, tests are available showing efficiencies of less than 20 per cent. Curves are given for both horsepower and kilowatt hours.

In Fig. 2 curves showing the power required to lift 1 second foot through a height of 1 foot for different efficiencies, are given, in terms of 100 gallons per minute. Fig. 3 gives similar curves expressed. Using a weight of 62.4 lb. per cu. ft for water, 0.1135 h.p. or .0847 kw. would be required to pump 1 sec. ft. 1 ft. high at 100 per cent efficiency. For 100 gallons per minute the corresponding figures are .0252 h.p. and .0188 kw. To lift one acre foot of water one foot high at 100 per cent efficiency requires 1.374 h.p.-hr. or 1.025

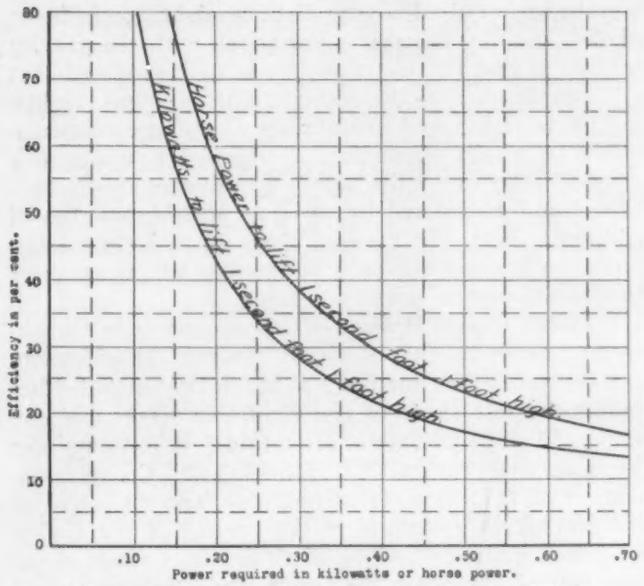

Efficiency in per cent.
Power required in kilowatts or horse power.
Horse Power to lift 1 second foot 1 foot high.
Kilowatts to lift 1 second foot 1 foot high.

Fig 2. Power Required to Pump 1 Second Foot 1 Foot High for Different Efficiencies.

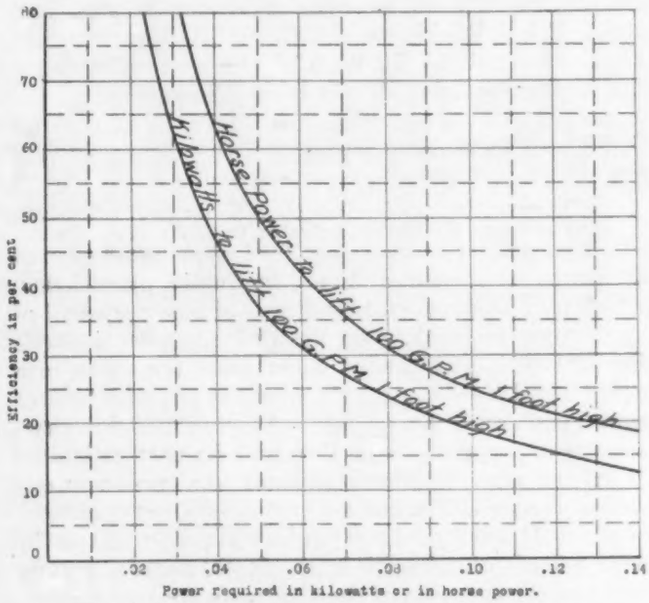

Efficiency in per cent
Power required in kilowatts or in horse power.
Horse Power to lift 100 G.P.M. 1 foot high.
Kilowatts to lift 100 G.P.M. 1 foot high.

Fig. 3. Power Required to Pump 100 Gallons Per Minute 1 Foot High for Different Efficiencies.

kw.-hr. The power requirements and consumption for estimated efficiencies, secured from these curves, multiplied by the lift in any case will give the total power requirement and consumption.

Aquatic growths in canals include a large variety of plants. The long, trailing growth, sometimes called horse tail moss, which grows from the sides and bottoms of canals and may reach a length of 6 or 8 feet, is in many cases actually a flowering plant of the pond weed family which is spread by seeds. The smaller non-branching black or frog moss is actually a moss botanically and has no flowers. It spreads by fragmentation, the breaking off of parts of the plants and its attachment in new locations. Algae are cellular growths which occur either in stagnant water or attached to other growths or surfaces. They are able to attach themselves sufciently firmly to even concrete surfaces so that they can resist relatively high velocities.

PROSPECTIVE POWER MARKET FOR IRRIGATION PUMPING IN OREGON AND WASHINGTON.

BY JOSEPH JACOBS.

(Continued.)

Three Rivers Slope.—This project contemplates the irrigation of 42,000 acres of plateau land lying in the gore between the Snake, the Columbia and the Walla Walla rivers and just above the existing irrigation projects of the Burbank Company and the Attalia Land Company. These latter named projects serve lands, partly by gravity but mostly by pumping, up to an elevation of about 420 ft. (mean sea level), and the proposed larger project here considered proposes to reach a maximum elevation of 850 ft., contemplating a maximum lift of 487 ft. and a mean lift of 343 ft., from a pumping station located on the left or south shore of Snake River in Sec. 2, T. 9 N., R. 33 E., W. M.

The project is well located for local markets, being about equidistant from Portland, Spokane and Seattle, and its transportation facilities are exceptionally good. Besides such transportation as the Columbia and Snake Rivers may afford, the project is practically encircled by railway lines and the Eureka branch of the Northern Pacific Railway crosses the project centrally in a northeasterly direction. The estimated cost of the project is as follows:

Pumping station complete	$ 460,000
Pressure mains	85,000
Main canals and distribution system	1,400,000
Engineering and contingencies	486,000
Total	$2,431,000
Cost per acre for 42,000 irrigable acres	$58.00

A possible gravity alternative for this project may be found in the Touchet River, which affords a reservoir site of good capacity, with damsite in the vicinity of Shaw, in Sec. 6, T. 9 N., R. 35 E., at which point the river elevation is about 880 ft. The ordinary summer flow of the Touchet River is all appropriated and in use for irrigation, but its flood discharge would be available. Practically no stream flow data are available for this stream from which its annual runoff could be estimated, but with a drainage area of about 600 square miles above the reservoir site and embracing an area whose annual rainfall varies from 13 in. to 36 in. per year, a mean annual runoff of from 150,000 to 200,000 acre feet might be anticipated, a large portion of which would be available for storage.

The Touchet River would probably not afford a sufficient supply to reclaim the entire 42,000 acres in the Three River scheme, but it might be made to serve the upper 20,000 acres thereof and thereby reduce the pumpage lift for the remaining lands by about 200 ft. This Touchet supply might also be considered for pumpage from the reservoir to areas above the 850 ft. level now contemplated, for these higher lands are of excellent quality and will require less leveling than the lower lands. I refer to these alternatives as possibilities which should receive consideration when more definite knowledge is had of the runoff of Touchet River, but which in the absence of such knowledge cannot be regarded so favorably as pumpage from the Snake.

Pasco Project.—This project embraces about 100,000 acres gross or 80,000 acres of irrigable land lying along the Columbia and Snake Rivers just northerly

from Pasco, exclusive however of the 20,000 acres gross included within the boundaries of the Pasco Reclamation Company's project. It contemplates pumpage in three lifts of a maximum elevation of 700 ft. above sea level, which means a maximum pumpage head, including friction losses, of 355 ft., and a mean pumpage head of 265 ft. The proposed location for pumpage station is on the Columbia River in Sec. 2, T. 10 N., R. 28 E., W. M.

This project is immediately across the Snake River from the Three Rivers Slope project hereinbefore described, and its transportation and marketing facilities are of the same excellence described for the latter project. Certainly this location at the confluence of two great rivers whose navigability is being constantly improved, and at the cross-roads of three great railroad systems, and embracing an area susceptible of high agricultural development, must be regarded as strategic and one that vouchsafes to that immediate district a future growth in population and industry probably beyond that of any other interior section of the state.

The soil is of the sandy loam variety of from 2 ft. to 8 ft. in depth and resting generally upon a rather porous underbody of sand and gravel, which makes for good drainage but does not tend toward a high duty of water. Upon the assumption that 40 per cent of the area would be devoted to fruit culture and that the canals would for the most part be concrete lined, I have fixed upon a delivery duty to the land of 33 in. and a pumping duty of 41.25 in. for an irrigation season extending from March 15 to October 15. The cost estimate for the project, omitting details, was made up as follows:

Pumping station complete	$ 560,000
Pressure mains	65,000
Main canals and distribution systems	2,730,000
Engineering and contingencies	671,000
Total	$4,026,000
Cost per acre for 80,000 irrigable acres	$50.33

In connection with the above estimate it should be stated that I have considered but a single pumping station on the Columbia River with consequent long canals to cover all the land, whereas a detailed study of the project may prove that an additional pumping station at the extreme southeast corner of the project, on Snake River, would be a more economical arrangement. Attention should also be called to the fact that some canals may not require concrete lining as was assumed or that such lining could be deferred several years until actually required by the increasing area in cultivation. This would tend to reduce initial cost and thereby also the annual cost during the earlier years of development when the landowner is less able to meet these costs.

The board of engineers recently appointed by the Federal Government and the state of Washington to report upon the Palouse project, which embraces the identical area herein considered, estimated the cost of a gravity development with water supply from the Palouse River at from $102 to $123 per acre. Taking $110 an acre as a basis for probable gravity cost, I have estimated that the annual cost for maintenance and operation, including interest, depreciation and taxes, would be $13 per acre, or it would, in other words, be just above that estimated for the proposed pumping scheme. In addition to the lesser initial investment required, a very distinct advantage in favor of the pumping scheme as compared with the gravity scheme is that the water supply is unlimited and that all complication as to water rights, power rights, interstate rights and uncertainty of storage efficiency would be wholly eliminated, all of which complications were adverted to by the board of engineers above mentioned and considered by them as possible sources of additional cost. In view of these facts I regard the pumping scheme not only as feasible but as superior to the alternative gravity scheme.

Priest Rapids Project.—This project is in the extreme southerly end of Grant County, Washington, and embraces that fine body of bench land included between the left shore of the Columbia River and the southerly slope of Saddle Mountain. It contemplates pumpage to elevation 900 ft. (M.S.L.) and the reclamation of 119,000 acres of irrigable land exclusive of the 7000 acres embraced in the project of the Haven irrigation Company, whose ditch line is at about elevation 460 ft. To reach the elevation first above named there is required a maximum lift of 430 ft. and a mean lift of 316 ft. from a pumping station located just above Priest Rapids on the Columbia River, in Sec. 15, T. 15 N., R. 23 E., W. M. The cost estimate for the project, omitting details is as follows:

Pumping station complete	$1,065,000
Pressure mains	200,000
Main canals and distribution system	3,347,000
Engineering contingencies	922,000
Total	$5,534,000
Cost per acre for 112,000 irrigable acres	$49.41

This project as above outlined must be considered in comparison with a direct hydraulic lift scheme, which may be developed by means of a power canal of large capacity heading on the Columbia River above Priest Rapids and carried down some ten miles to a point well below the rapids, where an effective head of some 60 ft. could be secured. A project of this character was reported on in 1906 and its cost estimated at $85 per acre. It embraced lands to a maximum elevation of only 762 ft. and covered 104,600 acres of land, of which 11,200 acres came under a gravity canal on the west side of Columbia River and 34,900 under a gravity canal on the east side of the Columbia River. A maximum lift of 291 ft. and a mean lift of 131 ft. were contemplated in this development. No estimate has ever been made of the probable cost of a direct hydraulic lift plant contemplating the higher elevations proposed for the electric pumping scheme, and if the original figure of $85 for the lower lift is correct it is probable that the cost of a similar plant, capable of reaching the higher elevations now contemplated, would be sufficiently high to make the proposed electric power pumping project the more economical.

(To be continued.)

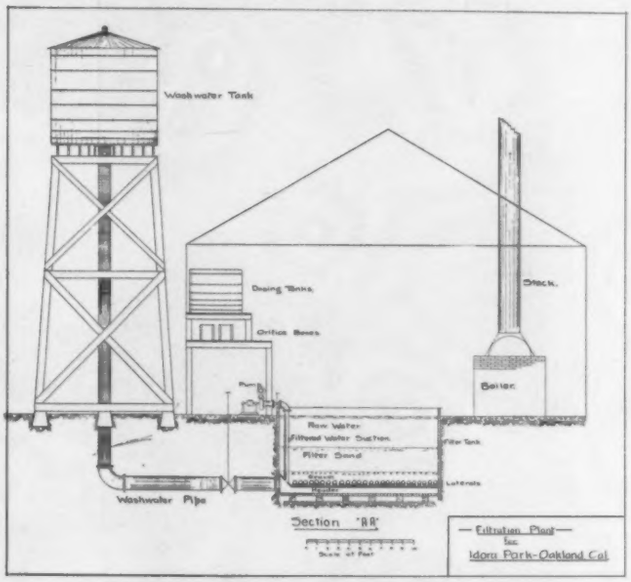
The area of canal rights of way generally varies from 1 to 2 per cent of the area irrigated. It is greatest where delivery is made to each farm on systems where the farms are small. Where the vegetation on the canal banks is kept under control either by seeding, mowing, cultivation or by other means, the manager of a system covering 50,000 acres will also be quite a farmer as the area in canal rights of way may vary from 500 to 1000 acres, of which one-half may be in canal banks.

FILTRATION PLANT AT IDORA PARK.

BY E. C. EATON.

Early in the present year the management of Idora Park, Oakland, Cal., decided to construct as an additional attraction for the Park, an open air swimming pool of 500,000 gallons capacity, having an over all length of 200 ft., width 75 ft., and maximum depth 9 ft. Owing to the distance, over three miles, to the nearest point from which the water could be pumped from San Francisco Bay, and the fact that water is available from underground sources within the park limits, a fresh water system was decided upon.

A filtration system having a capacity of half a million gallons daily has been put in, by means of which the entire content of the pool is filtered and treated daily, and in addition it is intended to add fresh water continuously at the rate of 15 per cent, making one complete change of water a week, in addition to the continuous filtration daily.



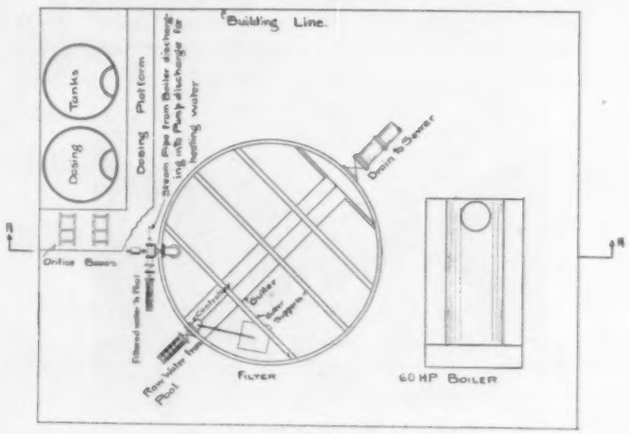
Plan of Filter Plant.

Filtration Plant.

The filter is of the rapid sand, gravity type, especially designed for the requirements. The gravity type was chosen as best meeting requirements for removal of lint and foreign particles, and accessibility, giving at all times a clear indication as to whether the proper blanket or floc is being formed and the washing carried out efficiently.

The plant is about 200 ft. from the swimming pool where the ground surface is about 5 ft. lower than the normal water surface in the pool. To enable the full 5 ft. head to be available for a gravity raw water supply, the filter tank, consisting of a redwood tank 15 ft. diam., 8 ft. high of 3 in. staves and bottom, was set on sills and chime joists, in an excavation, so that the upper edge of the tank is 9 in. above ground and the normal water surface in the filter is at approximately the ground level.

The ⅝ in. bands on the tank were given several coats of asphaltum, applied hot, and the space around the tank backfilled with earth. In the bottom of the filter tank a header is run across the whole width of the filter. This header is of tapered section, each section bejng designed to allow for the total quantity of water discharged into the header from the laterals with a minimum loss in friction, and an even increase in velocity from one end to the other. For the sake of economy this header was made of dressed lumber fastened to the bottom of the filter with iron straps and lags. After the header was in place, pressure was applied and the few small leaks well calked with wood. The header was designed so that the loss in friction head in each section is nearly made up for by the gain in velocity head, thus providing for an equal supply of water to each lateral during washing. In the top of the header wrought iron nipples are inserted connected to 3½ in. tees, from which lateral pipes were run across the filter at right angles to the header. These laterals are spaced 6 in. centers and are of such a size that the loss in each hole is 2 ft. head during washing, at the required washwater rate. Over the laterals four layers of gravel are placed, tapering from large to small



Section of Filter Plant.

size from the bottom to the top, and over this is placed 27 in. of filter sand having an effective size of 36 m/m. and a uniformity coefficient of 1.91. The head of water over the sand is 37 in.

The raw water supply from the swimming pool is by gravity through an 8 in. wood stave pipe, and a constant head of water over the sand is maintained by means of a specially constructed float valve.

From the discharge end of the filter header a 6 in. suction pipe is brought to a 4 in. centrifugal pump returning the filtered water through a 6 in. wood pipe line to the swimming pool. All supply and discharge pipe lines between filter and pool are wire-wound wood stave with the exception of the drain carrying the washwater to the sewer, which is ironstone pipe. The rate of filtration is regulated by means of the discharge valve on the pump, keeping the flow at a constant rate, as shown by a Pitot tube in the discharge line.

Washwater System.

No mechanical rakes or air wash are employed, these being replaced by using a high velocity washwater system, in which washwater at a high rate passes through the laterals, up through the sand, and is caught by a V-shaped wood gutter connecting with the sewer. The water for washing is supplied from a wood tank elevated on a trestle, from which a wood

stave pipe is run to one end of the filter header and the flow controlled by a gate valve. The tank is supplied from the local water supply derived from wells in the park. The sand is washed when the loss of head in the sand reaches 8 ft., the depth of the filter tank. A bacteriological analysis of the filtered water when the pool had been in use 7 days, gave a count of 5 per c.c.

Coagulant.

Aluminum sulphate is employed as a coagulant to produce the floc blanket on the filter. A 500 gallon wood tank is mounted on a platform of such a height as to allow a gravity flow to the raw water pipeline. This tank is provided with a semi-circular compartment having a screen bottom in which the sulphate crystals are placed and dissolved by spraying water into this compartment by a distributor until a solution of the required strength is obtained. The solution is

Street Lighting at Vallejo, Cal.

drawn off from these tanks through a ball cock in an orifice box, by means of which a constant head is maintained over a ¼ in. orifice in the orifice box corresponding to the required dosing rate. From the orifice the solution is collected in a lead tunnel and runs to the raw water pipe line.

A liquid chlorine equipment manufactured by the Wallace & Tiernan Company has been ordered, and until its arrival the water is being treated with hypochlorite through an equipment similar to that employed for coagulant dosing.

A 60 h.p. horizontal tubular boiler is provided in the filter house, which maintains a constant temperature of 75 degrees in the swimming pool. No heater is employed, a jet of live steam being discharged into the discharge from the centrifugal pump.

The estimated costs of the various items comprising the plant are as follows, including engineering and supervision, the actual costs being somewhat less:

Filter:—Capacity 500,000 gal. per day	$1,500.00
Coagulant dosing equipment	102.00
Heating boiler and piping	1,135.00
Pump and belt	165.00
Connecting pipe lines, sewer, raw water, washwater, etc	2,100.00
Washwater tank and trestle	450.00
Total	$5,452.00

The plant was approved by Mr. Guy L. Bayley, consulting engineer, and designed and constructed by the writer.

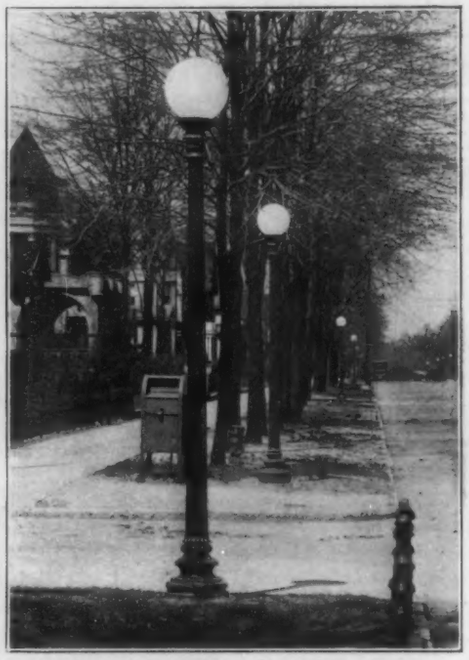
STREET LIGHTING.

BY WALDO C. COLE.

Street lighting can generally be considered under three classes: the business district, the residential district, and the outlying territory.

In the business district of a city, the illumination should be more or less brilliant, but not garish, as uniform as possible and of sufficient intensity to aid in preventing traffic congestion, to assist in avoiding automobiles, and to keep from tripping over projecting paving stones.

In residential districts, the intensity of illumination should not be as high as in the business districts, but it should be well diffused and just sufficient to allow consultation of a note book for any memorandum desired, and to distinguish house numbers. In fact, it should approach as near as possible what might



Lighting Standards in Residential District.

be termed the light from an artificial full moon on a clear night.

In the outlying territory, street lighting is primarily intended for a marker or guide, to direct the drivers of vehicles and keep them from straying into ditches and fences along the way.

The lighting of a city or town streets is a problem that requires considerable thought. It can readily be understood that a system cannot be selected by rule of thumb, but is only correctly selected after considering each of the many factors which are peculiar to the particular city or town.

To secure the desired results in a business district, units of large candle power rating, provided with globes that will free the light source from glare, are necessary. The spacing should be such as to produce a uniform illumination. On the other hand, residence districts should be provided with units of smaller candle power rating; in this case the spacing that will give uniform distribution is not easy to determine, because the general physical surroundings vary

through such wide ranges; for example, a street with small yards and few shade trees may change in a few blocks to one with deep yards and shade trees. These changes in physical surroundings may mean that globes of different material may have to be used in order that the one essential of prime importance in residential street lighting be had, a soft, well diffused light.

The outlying territory needs less careful consideration.

The fixtures cannot be chosen at random, because pedestals or poles that are ungainly, or not in their proper environment, will detract during the daytime from the general pleasing appearance of a city street.

There is one fundamental point that should never be forgotten in the selection of a street lighting system and at the same time, none of the other fundamental points sacrificed. This one prime factor is that the greatest amount of light must be produced at the lowest consistent cost.

Street Lighting at Indianapolis.

The new street lighting system of Indianapolis represents one in which all of the factors essential for the successful illumination of a city's streets were considered. This system consists of a combination of alternating current series flame carbon arc lamps and gas filled incandescent lamps.

For the illumination of the down town streets and ordinary street crossings, 2632 ten-ampere Westinghouse series flame carbon arc lamps are used. These lamps are provided with carbons having a guaranteed life of 100 hours, the light produced being white and approximating daylight. The inner globe is clear, while the outer globe, in order to eliminate the glare of the light source and produce a well diffused light, is slightly opalescent. The lamps are mounted on ornamental metal poles, the ropes for lowering these lamps are run through each pole and not on the outside, thus in no way detracting from their appearance. To insure safety when trimming and inspecting a lamp, each is provided with an automatic Cutter cutout.

Incandescent nitrogen filled lamps used in the residential districts and for park lighting, are mounted on cast iron columns. The units vary in rating, depending upon the local conditions, from 150 to 400 candle power. They are all of the 10 ampere current type. In order to secure the soft, diffused light, so desirable with residential street lighting, each lamp is enclosed in an Alba globe; in the parks, drives and boulevards, Monax globes are used.

The successful combination of the two types of illuminating units was made possible by the selection of regulating transformers designed especially for this class of service. The ability to operate the two types of illuminating units on the same circuit has allowed the city of Indianapolis to provide the illumination best suited to each district without having to provide a system of many complications.

Another interesting installation is that of the Vallejo, Electric Light & Power Company at Vallejo, Cal., where 15 ampere, 400 c.p. series Type C. Mazda lamps are suspended at street crossings by Luxolite fixtures.

Pacific Gas & Electric Company's annual report for the fiscal year ended December 31, 1915, is a most interesting document regarding utility development. During the past ten years the gross earnings have more than doubled, the gross income for 1915 being $18,530,301.04. Of this amount, $9,924,482 was derived from sales of electricity, and $7,560,185 from the sale of gas, the remainder being due to operation of the Sacramento street railway system and sales of steam and water for irrigation and domestic purposes. The operating revenues of the electric department were derived as follows:

Commercial and residential business	$4,486,451
State, county and municipal business	787,612
Sales of power—Agricultural industry	354,171
Sales of power—Mining industry	650,740
Sales of power—Transportation industry	870,326
Sales of power—Manufacturing industry	1,663,099
Sales of power—Other electric light and power corporations	306,059
Sales of power—Commercial and miscellaneous	513,450
Panama-Pacific International Exposition—Light and power	291,146
Temporary lighting and power	1,418
Total	$9,924,482

Since 1907 the revenue from electricity has increased 57 per cent, the number of consumers 203 per cent, and the amount of current generated and purchased has increased 80 per cent. Half of this power is hydroelectric. It is estimated that 65 per cent of the current generated is sold, the losses totalling 35 per cent. The ten hydroelectric plants in the system have an installed capacity of 122,400 h.p., and the four steam plants 109,517 h.p. The system load factor was 59.4 per cent, and the peak demand 187,051 h.p. There are 1544 miles of high tension transmission lines, 146 substations, 3836 miles of distribution lines, and 827 miles of underground conduit. The connected load in motors, appliances and lamps is 525,541 h.p. The total paid in wages during the year was $5,198,000.

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The Engineer as a Promoter

The promotion of public utilities is a field to which an increasing number of engineers are devoting their talents. The engineer possesses many of the qualifications requisite for a successful promoter and can do much to raise the standards of a business that has sometimes fallen into disrepute because of the actions of a few scoundrels. Contrary to popular opinion, the Rufus Wallingford type is no longer a success as a promoter. Glittering generalities do not appeal to the man who has money to invest. He has learned to place his reliance only on a keen analysis based upon careful investigation by an expert in whom he can repose confidence.

As all public utilities are essentially engineering enterprises an engineer should be able to make a more intelligent investigation and analysis of the feasibility of a project than a general promoter or a lawyer. His knowledge enables him to discern the possibilities of utility development in new fields, his experience makes it possible for him to formulate the advantages to be derived, and his reputation inspires confidence in the mind of the investor.

Opportunities for new electric light and power plants, telephone, street railway, gas and water companies become scarcer every year. It requires good judgment to recognize the possibilities and probabilities. The best opportunities are not found fortuitously nor by those who hunt for them assiduously. An intimate acquaintance with both the field and the kind of service to be rendered is necessary.

Likewise in capitalizing the opportunity, the engineer promoter can draw on a fund of informaiton as to cost data and probable earnings that the ordinary promoter seldom possesses. Even when no new developments are feasible he can see the economies that may be effected by consolidation of existing utilities. These savings include not only the elimination of wasteful competition, but also the advantage of more continuous duty for expensive machinery and expert technical staffs. He is familiar with valuation and can formulate an equitable basis for consolidation of smaller plants.

Engineering experience is equally useful in determining possible failures. When a plan receives the endorsement of a conservative engineer it carries far more weight than from an over sanguine promoter who does not realize the practical difficulties to be overcome. Not only are costs, earnings and profits to be taken into consideration, but also such matters as franchises, rights of way and the attitude of regulating commissions, with all of which an engineer is necessarily familiar.

An engineer, also, is better able to take care of the preliminary surveys and construction which must be undertaken before capital will seriously consider a proposition. In recent years most engineers have become familiar with financial matters and under-

stand the several kinds of securities, bonds, preferred stocks and common stocks, which are needed in temporary and permanent financing.

Such services are deservedly profitable. The task is an exacting one, it requires good judgment, great skill and much time. Constructive work of this kind is difficult and requires men of exceptional ability. Consequently it is remunerative and well worth the attention of any engineer who feels the limitations of work of a strictly technical character.

Enhancing Corporate Integrity

Integrity, uprightness of character, is the first essential of personal efficiency. As a public service corporation is but a person magnified, integrity may likewise be regarded as the fundamental requirement for corporate efficiency. An examination of corporate character through the lense of individual character reveals ways for enhancing corporate integrity.

Integrity in the individual is made manifest by a clean, straight, dependable life,—conformity to the moral law. A man's character differs from his nature in that it includes acquired traits. Upright character can be gained by effort. It is a by-product of always doing the nearest duty well,—faithfulness in the discharge of an obligation. It has been aptly defined as what a person is as distinguished from what he is supposed to be.

Character is an active force which, like a spinning top, maintains its uprightness by virtue of its movement. Like a gyroscope, its very motion imparts stability. A person of integrity is not easily displaced. The sense of positive resistance suggested by a man of strong character is similar to the mass of a physical body which physicists believe is due to the rapid motion of its constituent electrons.

The work accomplished by this force of character is confidence. That a man have ability is not sufficient. To be successful he should also have the power to compel men to trust his ability. This power is uprightness of character, integrity.

What has been said regarding integrity in the individual applies as well to the public service corporation, which has recently acquired a soul susceptible to moral training and consequently to character building. The corporation was first found to have a soul when courts placed the responsibility for corporate acts upon corporate owners. No longer is it possible to enjoy corporation privileges without assuming corporation responsibilities. Every right has its duty. The one is forfeited when the other is evaded.

Consequently the corporation is being made to conform to the moral law, to lead a clean, straight, honest and dependable life. Corporate character is measured by faithfulness in the discharge of its obligation to serve. Just as a people judge a man by his character, so does the public judge the corporation.

Corporate character, like its outgrowth, public confidence, is a plant of slow growth. It is based upon years of honest, courteous and reliable service. Yet unlike its private counterpart, corporate reputation lags but slightly behind corporate character, which invariably becomes known to the public served.

Character is the framework of business, which is action based on the belief that the other fellow will do as he agrees. The Morris plan of loans prefers character to tangible security as the basis for credit. Stronger than a contract, more effective than courts, is strength of character in enhancing individual or corporate wholeness or soundness—integrity.

The Washington Water Code

One immediate result of the recent decision establishing the legality of the Oregon water code is a conference which has been held at Tacoma during the past week to prepare a similar code for Washington. Governor Lister called together a number of representative engineers, hydroelectric men, irrigationists and business men to discuss legislation which is to be submitted to the legislature for enactment.

As has already been pointed out in these columns, the Oregon code, with its provisions for the adjudication of water rights and its preferential provisions for water appropriation, forms an excellent model for other Western states. The continued prosperity of this territory is dependent upon the greater utilization of its water resources. Irrigation and power developments are closely inter-related and in turn form the basis for advance in all lines of trade and commerce.

"A Loss There Was"

Why does an electrical contractor invest a thousand dollars or twenty thousand dollars in supplies and equipment and then work himself down to white hair and a five-cent cigar just for the honor of paying rent and being called a contractor? Why doesn't he charge a profitable price for his work so that his payroll may be met with a smile, his jobber seek his business and his banker welcome his goings out and his comings in? Because he doesnt' know his costs. Isn't that the reason?

Just because some competitor foolishly bids too low is a mighty poor reason for bidding still lower in order to get a job. Is it not better to lose a job which a cost system shows to be unprofitable, than to do the wild guess act, get it, and lose the profit on two other good jobs?

The man who gets the losing contract is not the only loser. He also robs the man who charges a fair, honest and just price based on a knowledge of costs. He befogs the minds of the architect and owner, putting money into their pockets and taking it out of the industry where it legitimately belongs.

Why not put a stop to this foolishness. Let the contractor admit "a loss there was" but make up his mind that in the future a profit there'll be, not only for himself but for the other fellow.

PERSONALS

R. Tomlinson, an electrical contractor of Portland, Ore., is at San Francisco.

A. E. Arbogast, an electrical contractor of Los Angeles, is at San Francisco.

Wm. Bertrand of Bertrand Bros., Phoenix, Ariz., has been visiting San Francisco.

S. V. Walton, commercial manager Pacific Gas & Electric Company, is at Marysville.

F. H. Leggett, Pacific Coast manager Western Electric Company, is at Los Angeles.

Harry S. Whiting, president of the Pierson-Roeding Company, is at the Yosemite Valley.

C. A. Stephenson of the Elko-Lamoille Power Company of Elko, Nevada, is at San Francisco.

J. C. Plankinton, manager of the Hilo Electric Light Company, is at San Francisco, en route to the Islands.

E. A. Chloepek, store manager of the Kimball Electric Company of Oakland, Cal., is in Mendocino county.

J. M. Saunders, secretary and treasurer of the Pierson-Roeding Company is at Los Angeles and San Diego.

W. S. Greenfield, Western manager of the H. W. Johns Manville Company, leaves for Los Angeles next week.

H. F. Holland, Pacific Coast manager Simplex Electric Company, has returned to Los Angeles from San Francisco.

T. W. Simpson, Pacific Coast manager Federal Sign System (Electric) has returned to San Francisco from San Diego.

C. J. Wilson, assistant engineer electric distribution Pacific Gas & Electric Company, is visiting Yosemite Valley by auto.

Howard Aylsworth of the Aylsworth Agencies Company, has returned to San Francisco from an extended business trip throughout the East.

H. F. Hartzel, manager for the Baker-Joslyn Company of San Francisco, has been visiting that company's Los Angeles branch for the past week.

W. B. Lewis and **W. Todd**, salesmen for the Western Electric Company, have just returned from successful trips through Northern California.

J. W. Woods, manager of the Pacific Coast Specialties Company, Oakland, has just returned from a four weeks' auto trip through Southern California.

S. P. Russell of the H. W. Johns Manville Company has mustered 34 men from his company to march in the Preparedness Parade at San Francisco on July 22.

T. H. Dooling of the San Francisco office of the Electric Storage Battery Company, is at Nogales, Ariz., with Company B, Signal Corps, National Guard of California.

C. A. Rylander, formerly with the Western Electric Company of Seattle, is now office correspondent for the Electric Railway & Manufacturers' Supply Company at San Francisco.

Warren Murray, chief engineer of the Western Sugar Refining Company, has returned from the East, where he purchased electrical and steam turbine outfit for the extension of their plant.

F. A. Wood, Pacific Coast agent Gamewell Fire Alarm System is at Salt Lake City. **A. F. Brown**, salesman for the Gamewell Company has completed a trip through the Montana territory.

Barry Dibble has been appointed project manager of the Minidoka Project (Idaho) of the U. S. Reclamation Service with offices at Rupert, Idaho. Mr. Dibble will continue to act as electrical engineer for this project.

E. O. Shreve, local manager of the Apparatus Department of the General Electric Company, has returned to San Francisco from the East, where he has been visiting the various factories of the General Electric Company.

J. D. Grant, president of the California-Oregon Power Company; **J. D. McKee**, vice-president, and **Paul B. McKee**, assistant to the president, all of San Francisco, were recently in Siskiyou County on a tour of inspection of the big dam that company is now constructing at Copco, on the Klamath River.

Elmer Dover of Tacoma has not been succeeded as president of the Oregon Power Company by James A. Green, as was erroneously stated recently. Mr. Dover retains the position as well as the general managership of the Byllesby interests in the Northwest. Mr. Green has resigned as vice-president of the Northern Idaho & Montana Power Company, and his successor will be selected by Mr. Dover as general assistant.

OBITUARY.

J. Harry Pieper, assistant to general manager of the Southern California Edison Company, Comus of fourteenth congress and congressman of the thirteenth district of the Jovian Order, died of heart disease at his home in Los Angeles, July 11, 1916. Mr. Pieper was ex-president of the Los Angeles Ad Club and Los Angeles Jovian League, a prominent member of the Knights of Columbus, Elks, Jonathan Club and Los Angeles Athletic Club, and his demise will be deeply felt by his hosts of friends among the members of many organizations with which he was affiliated. Mr. Pieper started his career in the electrical business in Boston, coming to California about ten years ago, and since that time has been in the employ of the Southern California Edison Company. He was forty-seven years old, and leaves a widow to mourn his loss. W. A. Breckenridge, vice-president and general manager of the Southern California Edison Company, said: "Through the death of Mr. Pieper the Southern California Edison Company and the community has lost a progressive and constructive employee and citizen."

MEETING NOTICES.

Oregon Society of Engineers.

The regular mid-summer meeting of the Oregon Society of Engineers was held at a dinner in the Oregon Building, Portland, Thursday evening, July 6th. After the dinner, Rural Credits, Drainage and Irrigation were discussed. President W. S. Turner acted as chairman. The secretary read two sections of the constitution which had been found unsatisfactory, and after a discussion it was decided to submit the change to the society for its vote on same. The sections related to the election of new members and honorary members.

E. G. Hopson opened the discussion and said in part: "There is an absolute need for drainage on every irrigation project. He cited one project in Nevada containing 50,000 to 100,000 acres of arid land lying below sea level, where drainage with open ditches 3 to 4 ft. deep was a failure, because the ditches were too shallow, soon becoming clogged with vegetation. An experimental drain 8 to 10 ft. deep, with 12 to 16 in. tile in bottom, was more successful, and lowered the water table for about 1000 ft. on each side. These drains with wooden manholes every 80 ft. cost about $20 per acre drained. Wide, open ditches have been found to be better and can be installed for one-fifth the cost. They have been used successfully on the Truckee-Carson project. On the Malheur project in Oregon, open ditches 6 to 8 ft. and spaced from 330 to 660 ft. apart, have reclaimed land in three years. Theoretically, there is no need of a drainage system on irrigation projects, but the farmers always demand excessive quantities of water at the beginning of irrigation and to get rid of this excess it is always necessary to provide a drainage system. Some portions of a district is usually lower than others and drainage is necessary to keep the water down in these sections."

Mr. Graves told next of his experience in reclaiming alkali lands in the San Luis Valley, Colorado. He stated that in most government projects there is today about 70 to 80 per cent of waste lands due to lack of drainage. He also said that sugar beets would thrive on most alkali lands under proper cultivation and would help to get the alkali out of it. Engineers generally forget all about the drainage system and therefore figure cost too low.

J. P. Newell gave a short talk on the Jones bill. He fears that it is not practical, and the great temptation for the government engineers to protect their own reputation will have a tendency to cause them to report unfavorably on new projects.. The Interior Department at present has no fund available for the work and has no disposition to hurry matters. Furthermore, it will tend to kill all private projejcts, as all investors will want only guaranteed projects. He thinks it better for the states to handle the guarantee and get quick action, even if there are mistakes made, than to have indefinite delays caused by the U. S. Government system of guarantee. Mr. Broili thought the government would be no more particular with these projects than with their own reclamation projects which were not all successes. Mr. Newell felt that the government would be more likely to recommend a project under its own control and direction than one under the control of someone else. Mr. Hopson did not fear delay. He said that all government projects were a success as far as the government was concerned, but measured as private investments they were not as the returns were delayed for many years, and maybe to another generation. Mr. Graves also endorsed Mr. Hopson's remarks. Mr. Cunningham felt political influences would affect state guarantees more than federal. Mr. Turner asked why cannot district irrigation projects be financed now, under the Oregon law? If the present law is defective, should not the Oregon Society of Engineers make it their business to see that it is amended to make it more attractive to investors. The discussion was then closed.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The commission has issued a supplemental order approving stipulation filed by the Pacific Gas & Electric Company in which it agrees to set aside $7,000,000 out of income during the next seven years for conservation of its assets and protection of stockholders and bondholders. The funds so set aside are to remain uncapitalized. It is provided that the company shall have the right to apply against the above payments, payments made into sinking funds for each of the years above named.

The Great Western Power Company has filed an application with the commission for authority to sell $277,000 first mortgage 5 per cent 40-year bonds. The money is to be used in reimbursing its treasury for additions and improvements heretofore constructed.

The Corcoran Water & Gas Company, Corcoran, Kings County, has applied to the commission for authority to issue $10,000 6 per cent bonds, for the purpose of enlarging and improving its water system.

The Western States Gas & Electric Company has filed a supplemental application with the commission, asking its approval of a statement of expenditures made for extensions, etc., during May, amounting to $14,008.50. Under the company's trust deed it is entitled to receive from the trustee 75 per cent of the above sum on account of cash deposited with the trustee against which bonds have been issued.

The Oro Electric Corporation and its subsidiaries have applied for permission to sell and transfer all their properties to the Pacific Gas & Electric Company, which is to pay $1,491,151.35 for the properties. To meet the payment, the Pacific Gas & Electric Company wishes for authority to sell sufficient general and refunding mortgage gold bonds at not less than 85. The Oro Electric Corporation gives as it reasons for selling that it is without sufficient funds to develop its properties properly and to complete its hydroelectric projects on Yellow Creek and Mill Creek, the estimated cost of which, when completed, is $8,000,000, and will produce 130,000 h.p. of hydroelectric energy. The Pacific Company says it is desirous of acquiring reserve water power, and it believes it will be able to complete the Yellow and Mill Creek projects. The agreement for the merger was entered into last January.

NEWS OF THE OREGON PUBLIC SERVICE COMMISSION.

The commission has found $13,702 as the reproduction cost new, less depreciation, of the Clatskanie Light & Power Company of Clatskanie, Oregon, and, as the present rates are below those generally found for furnishing like service under comparable conditions and as they do not yield the necessary operating expenses, depreciation and taxes, has ordered a slight increase in accordance with the following schedule: Residence lighting—First 15 kw.-hr. used per month, 12c per kw.-hr.; next 15 kw.-hr. used per month, 10c per kw.-hr; all over 30 kw.-hr. used per month, 6c per kw.-hr; minimum monthly charge, $1. Commercial lighting—First 30 kw.-hr. used per month per kw. connected, 12c per kw.-hr.; next 30 kw.-hr. used per month per kw. connected, 10c per kw.-hr.; all over 60 kw.-hr used per month per kw. connected, 6c per kw.-hr.; minimum monthly charge, $1 per kw. connected, no minimum less than $1; No connected load considered less than 500 watts.

COMPARATIVE COST OF WIRING.

A recent booklet issued by the Society for Electrical Development gives the following figures for the comparative costs of wiring. Owing to varied costs of material and labor, as well as different restrictions required by authorities at different points, the table gives only comparative figures:

Knob and tube	$1.50 to $2.50
Flexible steel and armored conductors	2.00 to 5.00
Flexible steel conduit	3.50 to 5.50
Rigid metallic conduit	4.00 to 7.00

TRADE NOTES.

The H. B. Squires Company of San Francisco will represent the Alphaduct Company, having purchased from the Aylsworth Agencies Company their rights for the Pacific Coast.

Kimball Electric Company has recently taken a contract with the California Central Creameries Company at El Centro. This installation included a 270 h.p. General Electric motor and all the wiring for telephone and lighting system.

The Pacific Coast Specialties Company of Oakland has recently sold out its Los Angeles branch and will now be known as the W. C. Bailess Company. This branch covered sub-branches at Santa Barbara, at Anaheim, Long Beach and Pasadena. This company's branches will cover Fresno, Sacramento and Oakland. In Fresno they are selling out the electrical line only.

NEW CATALOGUES.

Bulletin No. 49103, from the General Electric Company, describes jacketless and the water jacketed Glue Pots.

Westinghouse Electric Ranges are attractively portrayed in Catalogue 8-D from Westinghouse Electric & Manufacturing Company.

Bulletin 48906 from Sprague Electric Works of General Electric Company, illustrates and describes Type S-1 Electric Hoists of ½ and 1 ton capacity.

NEWS NOTES

INCORPORATIONS.

BOISE, IDAHO.—Shelley Light & Power Company, $100,000, by J. F. Shelley, T. W. Shelley, Thos. Mitchell et al, all of Shelley.

ILLUMINATION.

TOMBSTONE, ARIZ.—An ordinance has been passed granting to Edgar L. Wright a franchise to construct and operate an electric light and power plant in this city.

IDAHO FALLS, IDAHO.—Messrs. Wilcox & Doyle, having secured 400 applications for the use of gas will begin the work of building the plant and laying the mains at once.

SNOWFLAKE, ARIZ.—Harry Steels, an electrician of Holbrook, was in Snowflake recently trying to interest the people in an electric light plant which he proposes to install here.

WATTS, CAL.—The council has signified its intention of improving Melvin avenue from the south line of Shorb avenue to the north line of Main street by the construction of ornamental electroliers on each side of the street.

LOS ANGELES, CAL.—The city council has adopted ordinances for the installation of a lighting system for lighting Adams street, between Figuerroa and Hoover and Adams between G and Figuerroa, and certain other streets.

SPOKANE, WASH.—Plans and estimates for the Main avenue ornamental curb lighting system have been filed with Commissioner Fassett by Chief Assistant City Engineer A. D. Butler. The estimate covers the installation and electric current for ten years.

LAGUNA BEACH, CAL.—Formation of a lighting district to comprise the principal subdivisions of Laguna is being considered. Circulation of petitions to be presented to the board of supervisors has been started for formation of such a district. It is proposed to light the principal thoroughfare from Arch Beach to McKnight's subdivision, with at least one additional street in each subdivision lighted.

TRANSPORTATION.

IDAHO FALLS, IDAHO.—It is now up to the city of Pocatello to grant a franchise for the electric road, and if this franchise is granted there is reason to believe that Pocatello will be made the division point between Salt Lake and Yellowstone, with a complete railway system for the city.

PORT TOWNSEND, WASH.—Engineers have finished a survey of the Port Townsend & Puget Sound Railroad, with a view to ascertaining the exact amount of steel required to replace the rails which have been in service. About 27¼ miles of track must be laid, and it is believed that the ties will have to be replaced.

WHITTIER, CAL.—Application has been made to the Board of Trustees of Whittier for a franchise to construct and for a period of 50 years to maintain an electric railroad on Philadelphia street and other streets. It is proposed to grant to the highest bidder a franchise on terms and conditions set forth in an ordinance granting the franchise. Sealed bids will received up to July 31st.

TELEPHONE AND TELEGRAPH.

DOWNIEVILLE, CAL.—The Pacific Telephone & Telegraph Company has decided to put an entire new line between Sierra City and Sierraville over the summit.

SPOKANE, WASH.—Improvements and general construction work on the Inland division of the Pacific Telephone & Telegraph Company and Spokane work of the Home Telephone Company, aggregating $51,420 were announced by C. E. Hickman, division commercial superintendent and general manager.

TROUTLAKE, WASH.—A telephone line will be constructed in Columbia forest by the forest service this season from Dead Horse Ranger station to Twin Buttes. The line will be 36 miles long.

SAN BERNARDINO, CAL.—Although the present franchise still runs for another year, the Pacific Telephone Company will shortly apply for a new franchise. A fight is expected over the dual phone system here.

FLORENCE, ARIZ.—E. Anderson, representing the Mountain States Telegraph & Telephone Company, reports that the company has completed arrangements for extending the phone line five miles up the river on the north side to a point where the river will be crossed and the line brought into town along the south side. The new arrangement will bring in new phone users on both sides of the river.

BERKELEY, CAL.—President Max Thelan and Commissioner E. J. Gordon of the State Railroad Commission conducted an inquiry into the rate and a proposed new basis of rates for the Pacific Telephone & Telegraph Company's service in the east bay cities at the Berkeley City Hall last week. The company's proposed readjustment of rates includes the establishment of a measured service for residence and business telephones. Further hearings will be held.

PORTLAND, ORE.—By unanimous vote the city council has passed one ordinance prohibiting the construction of any additional overhead poles and wires on the main streets of the Central East Side after June 1, 1917, and another ordinance requiring the removal of the present poles and wires by the end of 1919. The measure originally took in the entire Central East Side. As passed it takes in only the principal streets, including Union and Grand avenues and Hawthorne avenue and parallel streets north to Irving, between Third and Sixth streets.

TRANSMISSION.

REDDING, CAL.—A carload of electrical machinery for the Western States Gas & Electric Company, has arrived in Redding to be hauled by teams to the company's power plant near Junction City, Trinity county.

PRESCOTT, ARIZ.—G. B. Heller, engineer in charge of the projected Burro Creek electric power plant of Col. E. P. Thayer has gone to the site of the works, to install a water gauge system, the first move towards construction.

SPOKANE, WASH.—Engineers who have been figuring on power possibilities at the smelter site have reported that the river can be raised 80 ft. by a dam at the north end of the rocky gorge. The plan of power development is being considered by the Spokane Valley Power Company, which has applied to the council for a franchise.

IRRIGATION.

LAKEPORT, CAL.—Mary E. Jewell of Middletown applied for permission to appropriate 18 miners' inches of water of Gallagher Creek, for irrigation purposes.

MONTAGUE CAL.—A large tract in the vicinity of Granada will be put under irrigation as soon as water can be brought from the Shasta River through a pumping system.

VISALIA, CAL.—Superior Judge J. A. Allen has handed down his decision decreeing that the $283,000 Alpaugh Irrigation District bonds, voted some time ago, are legal, thus eliminating any doubt that may have existed and permitting the bond-buyers to buy the bonds without fear of their validity. The court was asked for the opinion by a petition of the district itself. The money from the bonds will develop thousands of acres of land in the Alpaugh district and protect it from the steadily rising waters of Tulare Lake.